



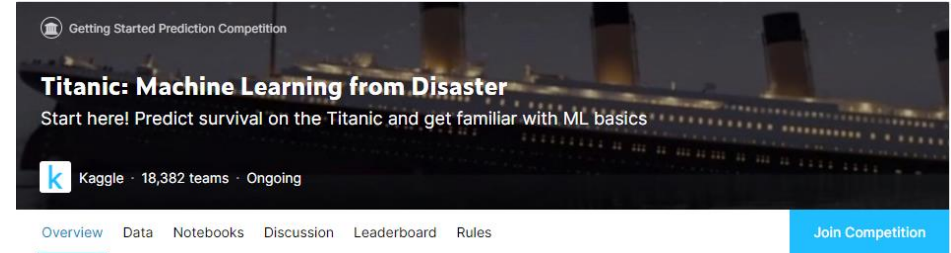
Introduction to Artificial Intelligence

**Prof. Chia-Yu Lin
Yuan Ze University
2021 Spring**

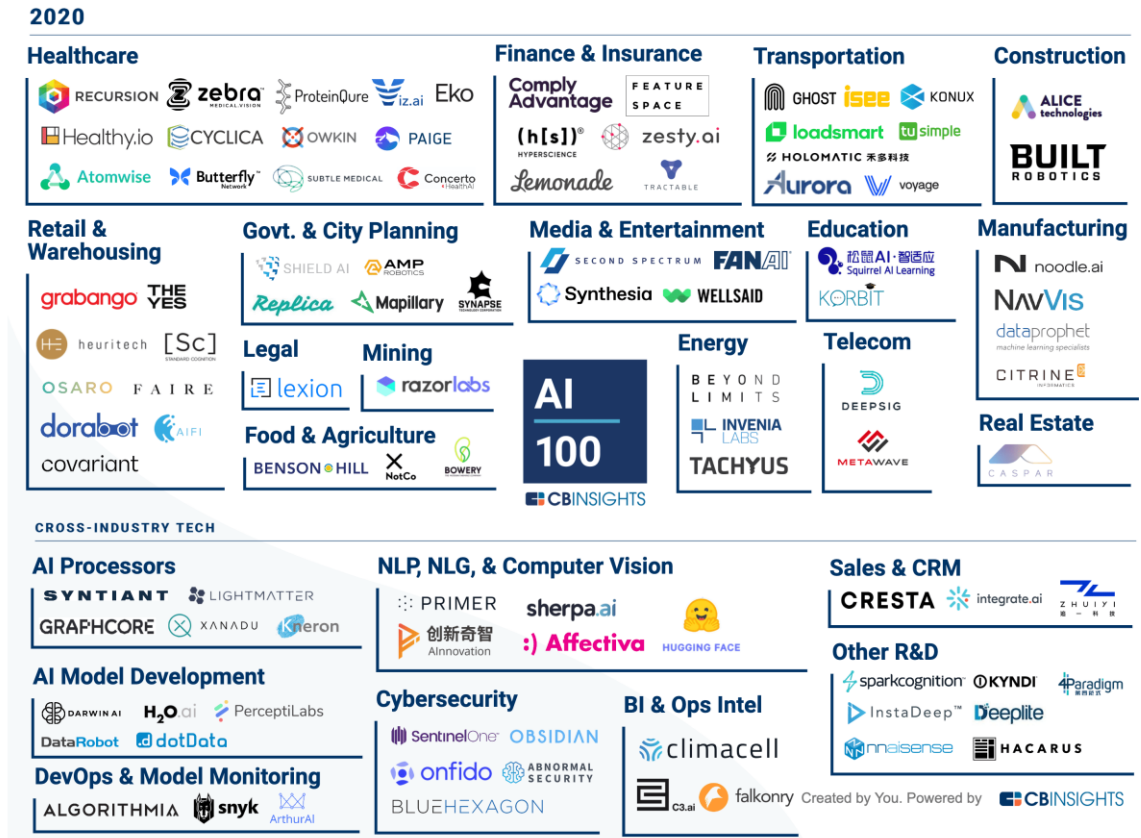
Thanks to the slides of Prof. P. Domingos from Washington University, Prof. H.-T. Lin and Prof. Lee Hung-Yi Lee from NTU.

After Learn AI.....

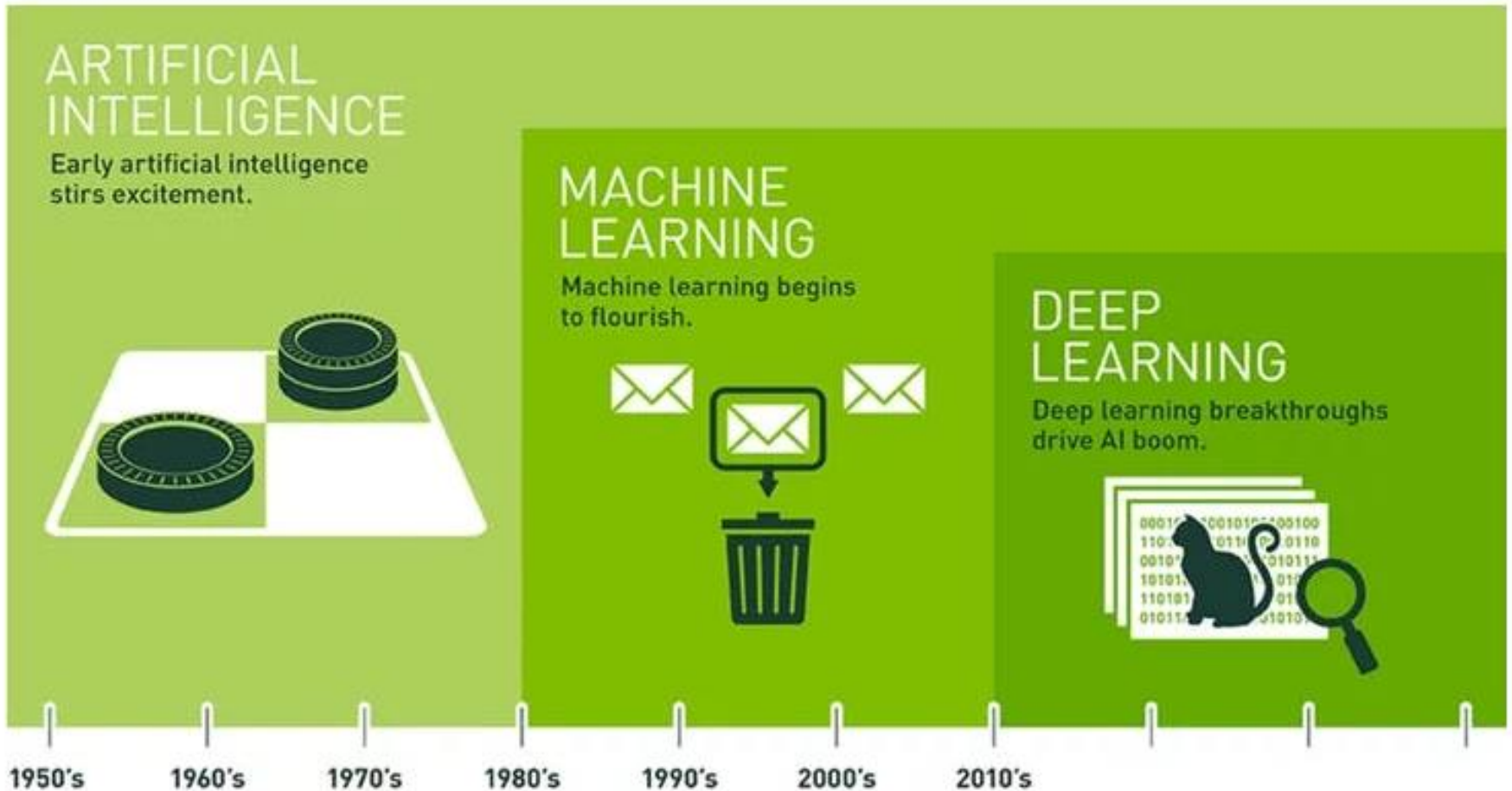
- Analyze historical event
 - Titanic



- Build autonomous
- Find a good job
- Build a startup



AI, ML, DL



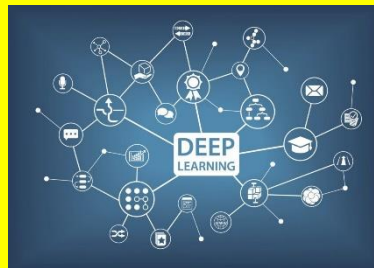
圖片來源：NVIDIA

Story of ML and DL

- 1950, Artificial Intelligence
- 1980-2006, Machine learning
 - 1980 Artificial Neural Network
 - 1986 Back Propagation is proposed to solve the complex computation in neural network.
 - Gradient Vanish Problem
 - Decision Tree, Forest Tree, Support Vector Machine, ...becomes popular.
- 2006, Prof. Hinton utilized Restricted Boltzmann Machine to train neural network.
- Bad impression of neural network. =>Deep Learning.
 - Decision Tree, Forest Tree, Support Vector Machine becomes shallow learning.

Story of ML and DL

- ImageNet is the biggest image recognition database in the world.
- In fact, since the launch of the ImageNet competition in 2007, the results of the error rate is roughly 30%, 29%, 28% in each year's competitions.
- 2012, Prof. Hinton used deep learning (AlexNet) to make error rate become 16.42%.



The Father of Deep Learning

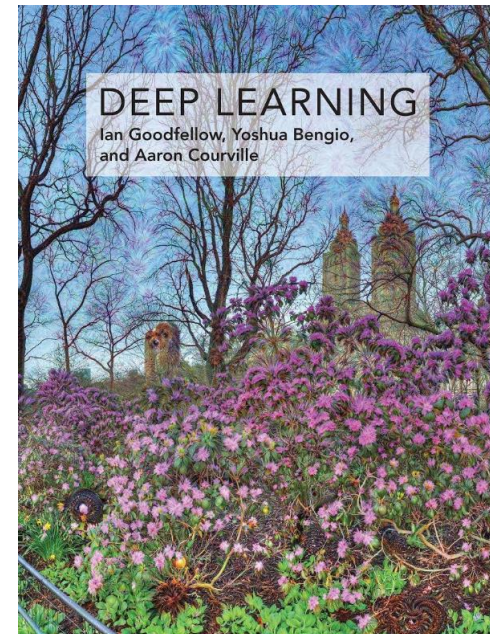
- 2013, Google bought the company of Prof. Geoffrey Hinton and his two students.
- Geoffrey Hinton becomes the father of deep learning.



AI三巨頭



- Geoffrey Hinton、Yoshua Bengio、Yann LeCun got **ACM Turing Award in 2018**.
- Geoffrey Hinton
 - Father of deep learning
- Yoshua Bengio
 - The author of Deep Learning book
- Yann LeCun
 - Father of CNN
- They share **self-labeling** will be the important topic in the next generation of AI.





What AI can do?

Predict the Price of Stock

Search Flights Find cheap flights and free airfare predictions

☒ Round Trip ☐ One Way ☐ Multi-City

• Please enter a To city

From:

Chicago, IL (CHI) - All airports

☐ Include Nearby Airports

To:

Seattle, WA (SEA) - Seattle/Tacoma

☐ Include Nearby Airports

7-Day Low Fare Prediction



Tip: Buy

Fares Rising \$42

Confidence: 66%

[Details](#)

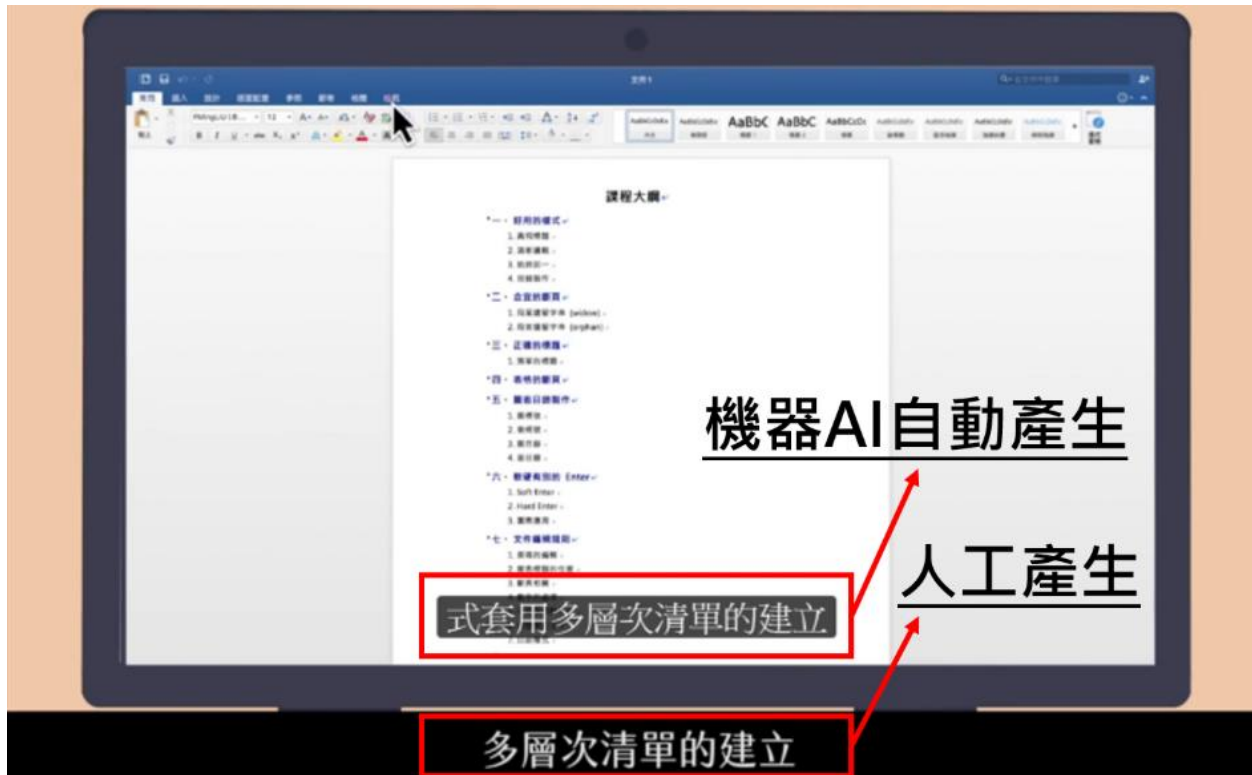
Applies to
ORD>SEA only

Daily Low Fare History



Automatic Speech Recognition

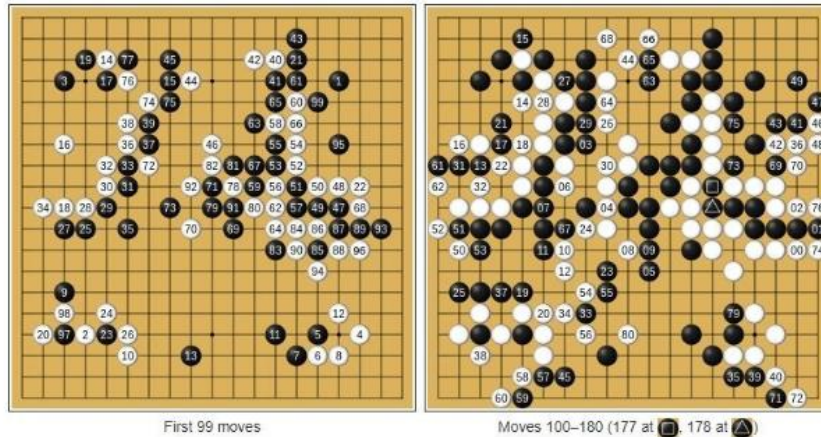
- Automatic Speech Recognition
 - Add subtitles automatically



Alpha Go

「神之一手」奪全球讚賀，卻認為贏在系統錯誤

與AlphaGo的第四局比賽中，執白子的李世乭下出的第78手棋——這被譽為「神之一手」的一步棋，讓AlphaGo表現失常，進而逆轉局勢拿下比賽。這局棋為世人所稱頌。韓國棋手安永吉（An Younggil）聲稱，這場比賽是李世乭的最傑出的一局棋，一場足以流芳後世的經典對弈。



李世乭對決AlphaGo第4局下出被世人譽為「神之一手」的78手，導致後續AlphaGo判斷失常，進而拿下比賽。

圖片來源：Wikipedia



外界相信，這一局向全球揭示了人類勝過電腦的可能性，但李世乭認為，他能從AlphaGo手中拿下一勝，是因為AI在面對出乎預料棋步時的「缺陷」。

Image Caption Generation

- Automatic Image Caption Generation



"man in black shirt is playing guitar."



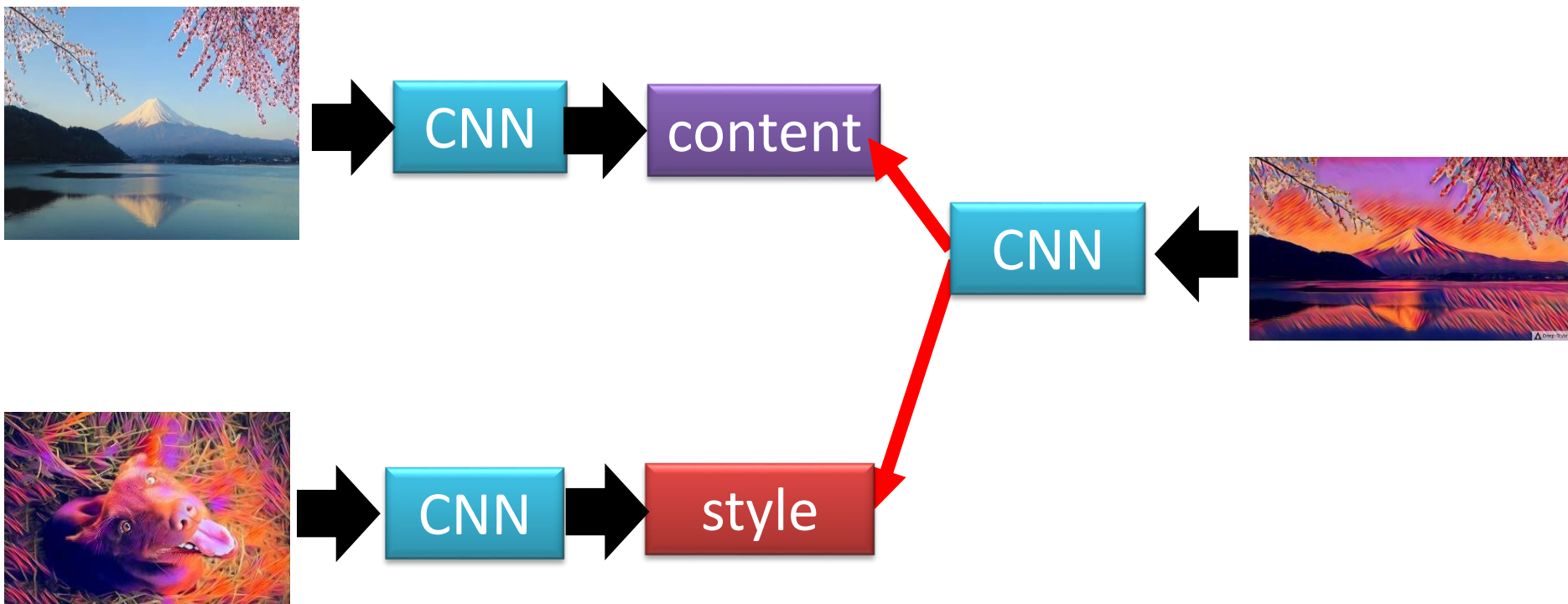
"construction worker in orange safety vest is working on road."



"two young girls are playing with lego toy."

Deep Style (1/2)

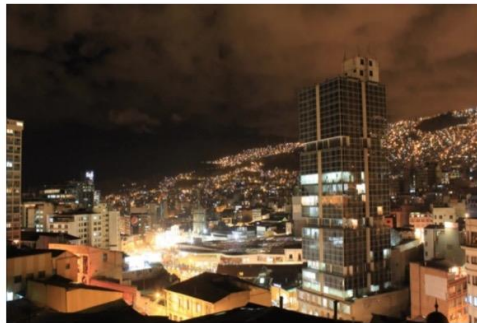
- Give a picture and transform to a famous painting.



Deep Style (2/2)



- Deep Photo Style Transfer



Fast Style Transfer



-

Face Generation

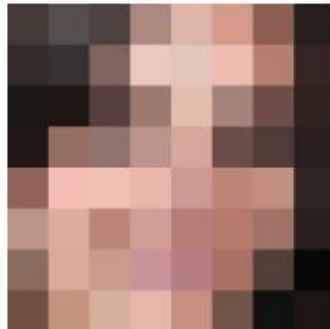
8×8 input



32×32 samples

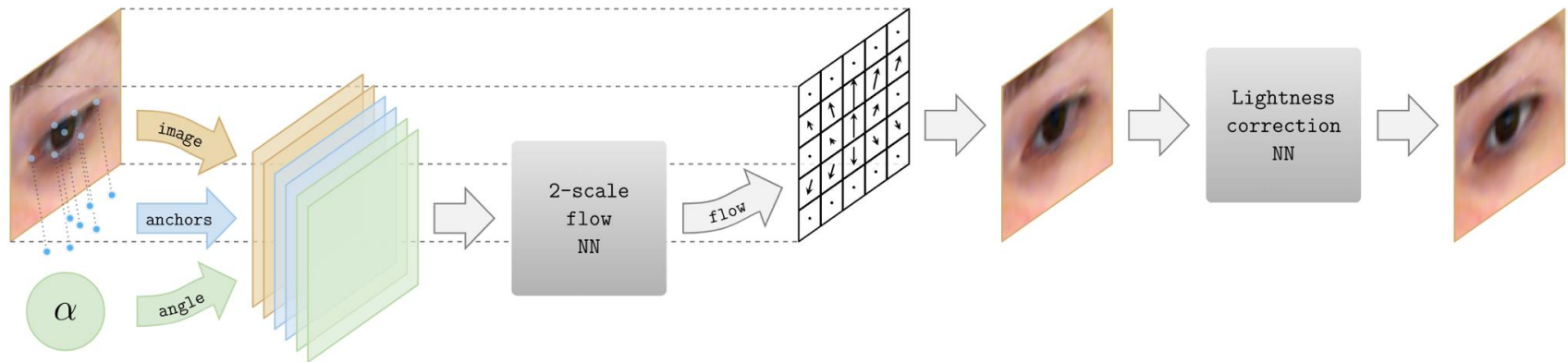


ground truth



DeepWarp (1/3)

- Add dynamic eyeballs to static pictures.
- <http://sites.skoltech.ru/compvision/projects/deepwarp/>



DeepWarp (2/3)



DeepWarp (3/3)



Lipnet

- LipNet: End-to-End Sentence-level Lipreading
- <https://youtu.be/fa5QGremQf8>



Music generation

- Which one is the generated music?

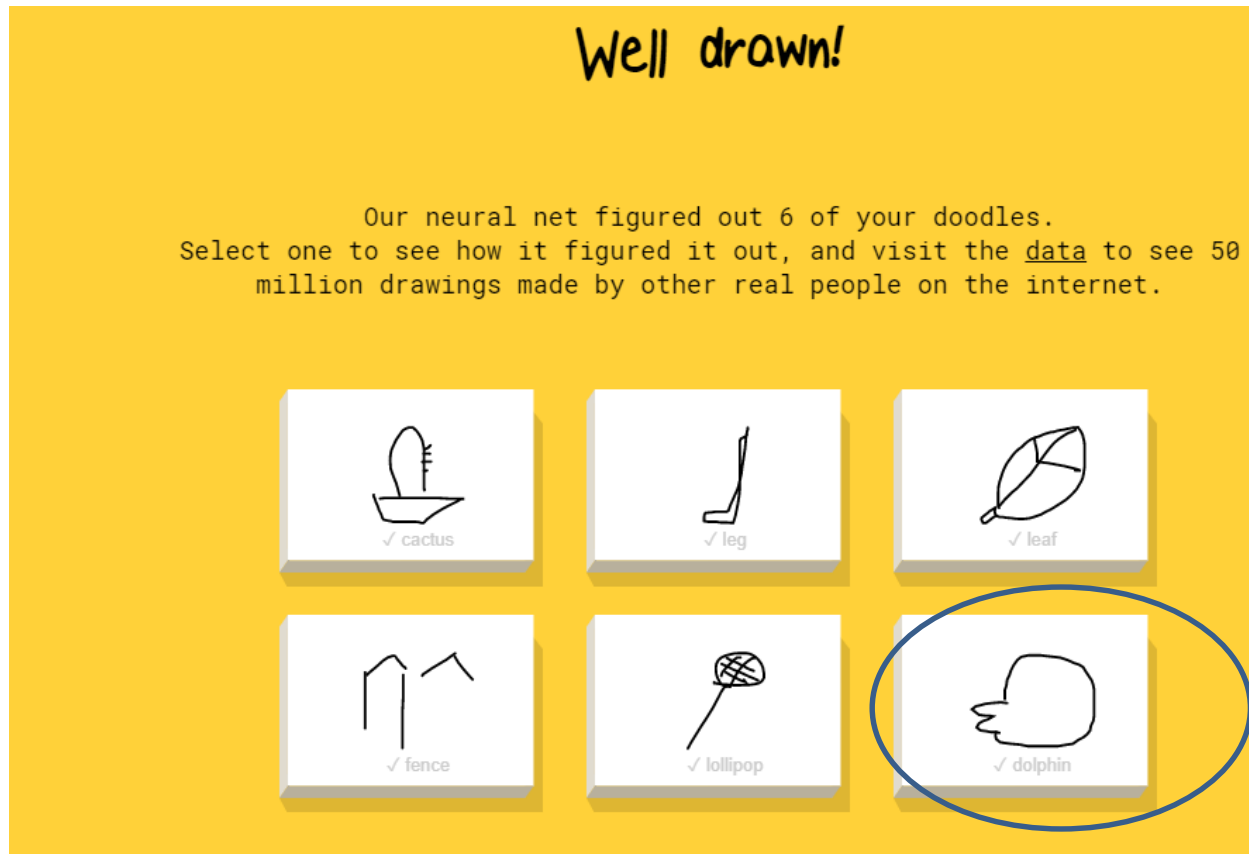


This is generated by AI.



Google Quick Draw

- Differentiate what you are drawing
- <https://quickdraw.withgoogle.com/>



The model is good training!!

AI is so Powerful



- What can I do?
- Don' t worried. Learn AI now and you can become AI' s teacher.

From Learning to Artificial Intelligence

- What's learning?
 - knowledge or skill acquired by instruction or study



- What's artificial intelligence?



From Learning to Artificial Intelligence

- What's learning?
 - knowledge or skill acquired by instruction or study



- What's artificial intelligence?



- Acquiring skill with experience accumulated/computed from data
 - Make machines act like human
- What's skill?

Skill

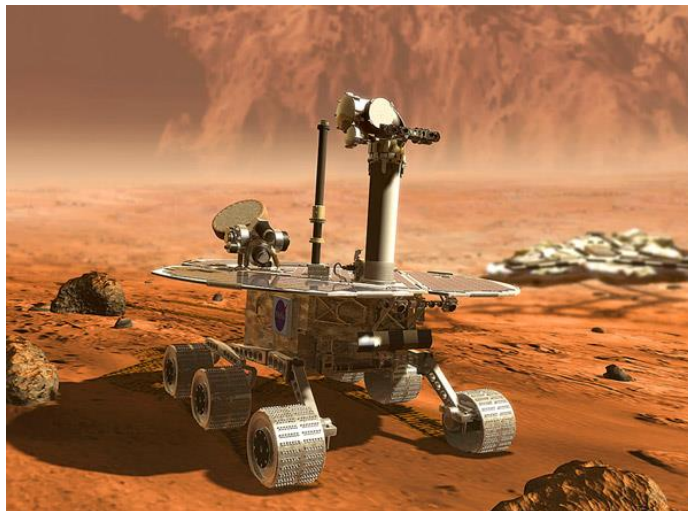
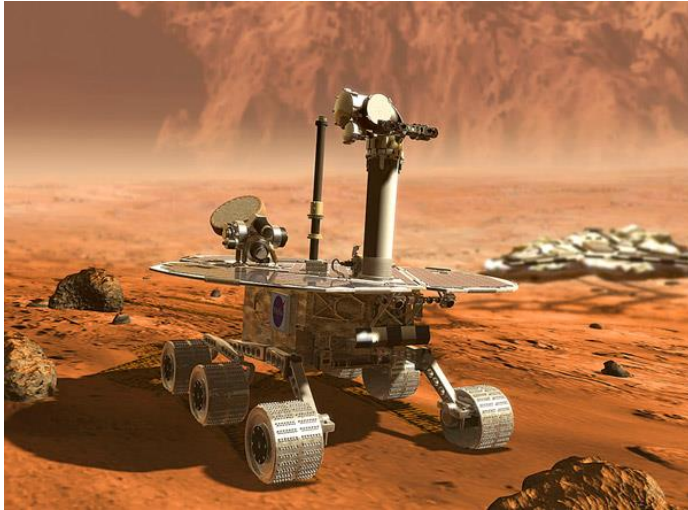
- Skill: improve the performance measurements (e.g., prediction, 3pts shooting percentage)
- Therefore, machine learning is defined to be the **improvements on some performance measurements** by **computing from data**.
- For example,
 - **Network data** -> **ML** -> **Better flow control**
 - **Signal data** -> **ML** -> **Faster antenna direction detection**
 - **Sequential web log data** -> **ML** -> **Higher accuracy of anomaly detection/efficiency of caching algorithm**
 - **Stock data** -> **ML** -> **More money**

AI



- AI: an **alternative route** to build complicated systems
- Some Use Scenarios
 - when human **cannot program the system manually**
 - navigating on Mars
 - when human **cannot 'define the solution' easily**
 - speech/visual recognition
 - when needing **rapid decisions** that humans cannot do
 - high-frequency trading
 - when needing to be user-oriented in **a massive scale**
 - consumer-targeted marketing

Navigating on Mars



Visual Recognition

- Describe this thing using the appearance



Key Essence of AI

- Exists some 'underlying pattern' to be learned
 - So performance measure can be improved
- But no programmable (easy) definition
 - So AI is required
- Somehow there is data about the pattern
 - So AI has inputs to learn from

Which of the following is best suited for machine learning?

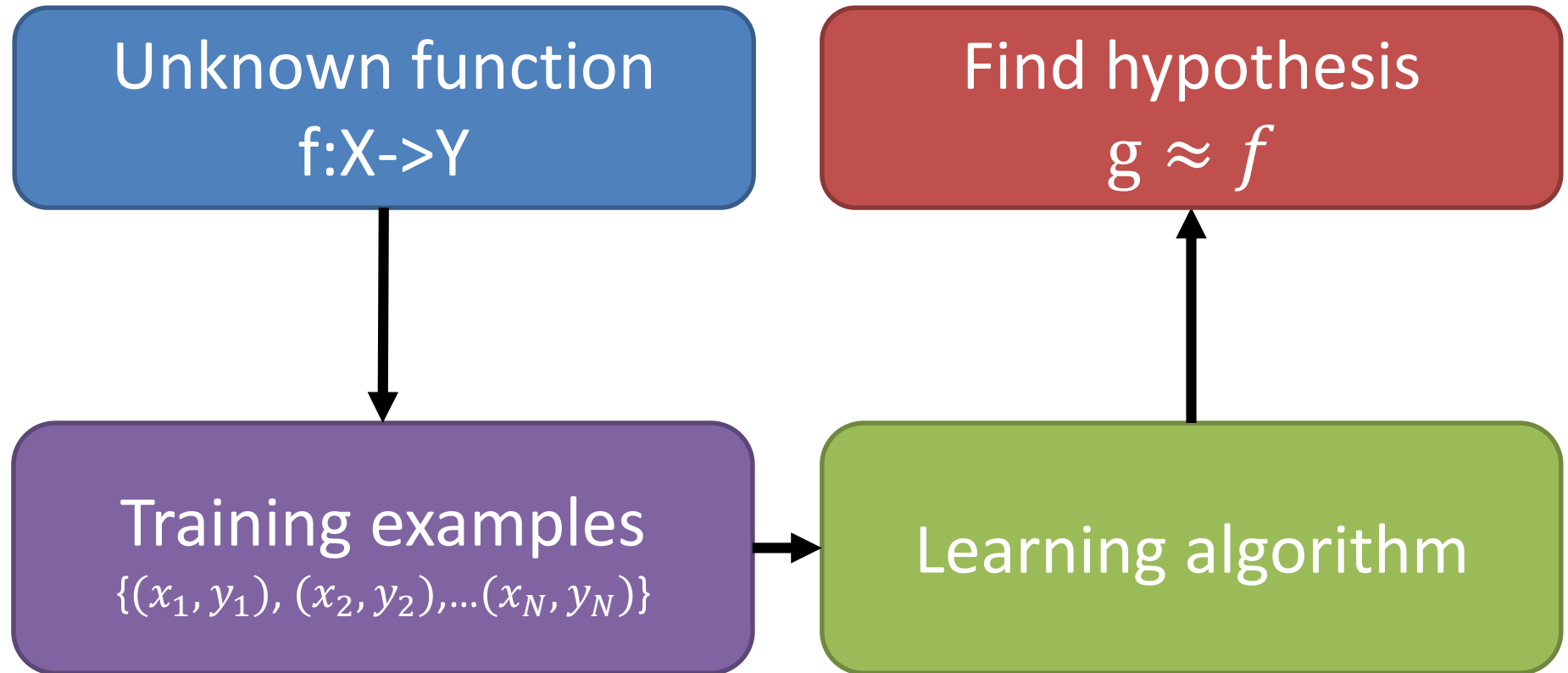


- 1. predicting whether the next cry of the baby girl happens at an even-numbered minute or not?
- 2. determining whether a given graph contains a cycle
- 3. deciding whether to approve credit card to some customer
- 4. guessing whether the earth will be destroyed by the misuse of nuclear power in the next ten years

Learning Problem Formulation

- Notation
 - **Input:** $x \in X$ (application)
 - **Output:** $y \in Y$ (good/bad after approving)
 - **Unknown pattern to be learned can be formulated as a function**
 - $f: X \rightarrow Y$ (ideal function)
 - **Data:** $D = \{(x_1, y_1), (x_2, y_2), \dots, (x_N, y_N)\}$
 - **Hypothesis:**
 - $g: X \rightarrow Y$ (hopefully can be as close to f as possible)

Learning Flow



- **Artificial Intelligence:** use **data** to compute **hypothesis** g that approximates **target** f

Learning is to find a function

- Voice Recognition

$f(\text{$



$) = \text{鳥叫聲}$

- Speech Recognition

$f(\text{$



$) = \text{“我不知道你說什麼”}$

- Image recognition

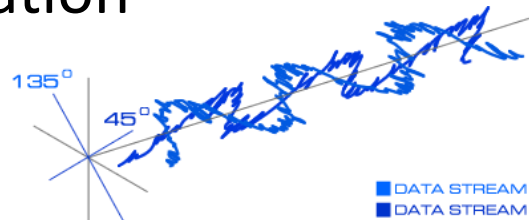
$f(\text{$



$) = \text{“Seafood”}$

- Channel estimation

$f(\text{$



$) = \text{Channel parameters}$

http://cdn1.itpro.co.uk/sites/itpro/files/images/dir_176/it_photo_88225.jpg

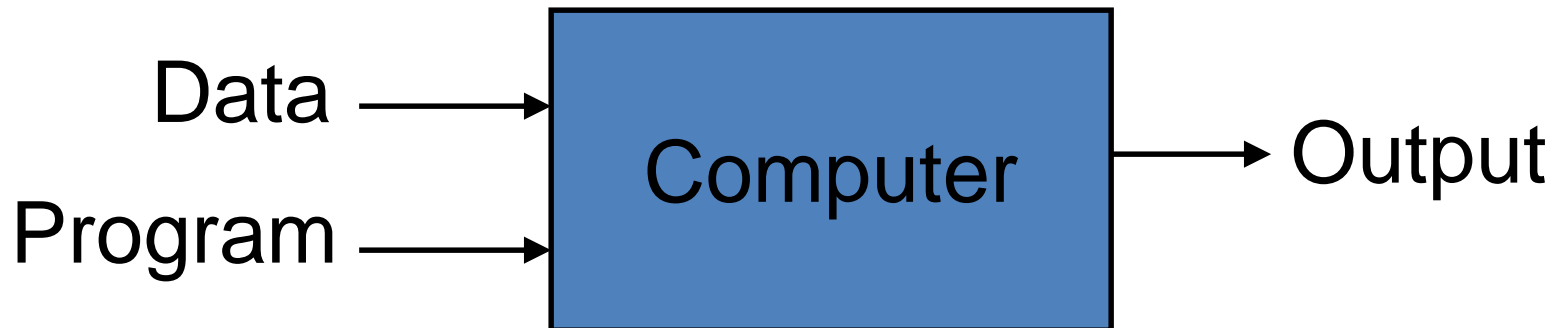
http://www.berkeleywellness.com/sites/default/files/field/image/ThinkstockPhotos-520490716_field_img_hero_988_380.jp

<https://telcoantennas.com.au/site/sites/default/files/images/4G-cross-polarisation-low-signal-areas.png>

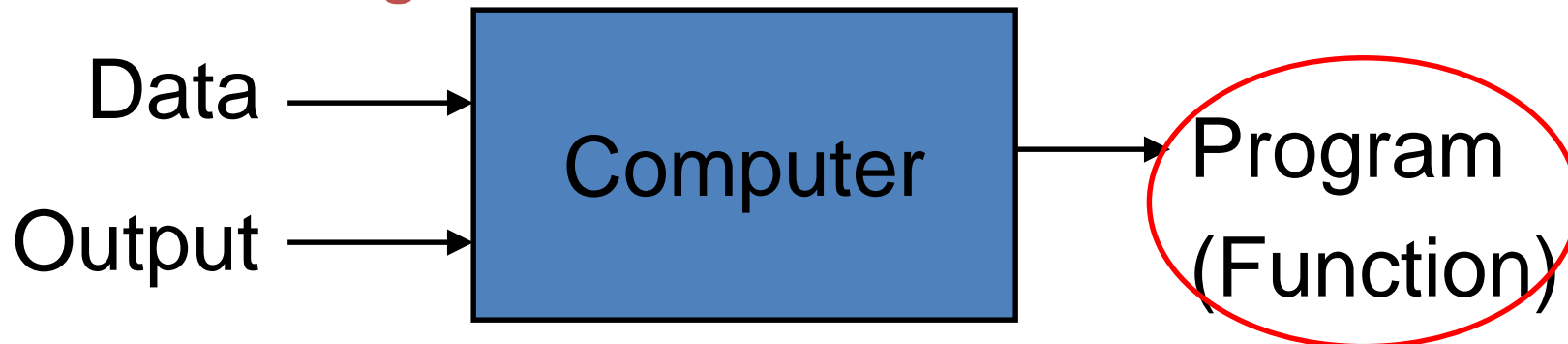
Traditional Programming vs. ML



Traditional Programming



Machine Learning



Learning is to
find a function!!

AI is so Easy

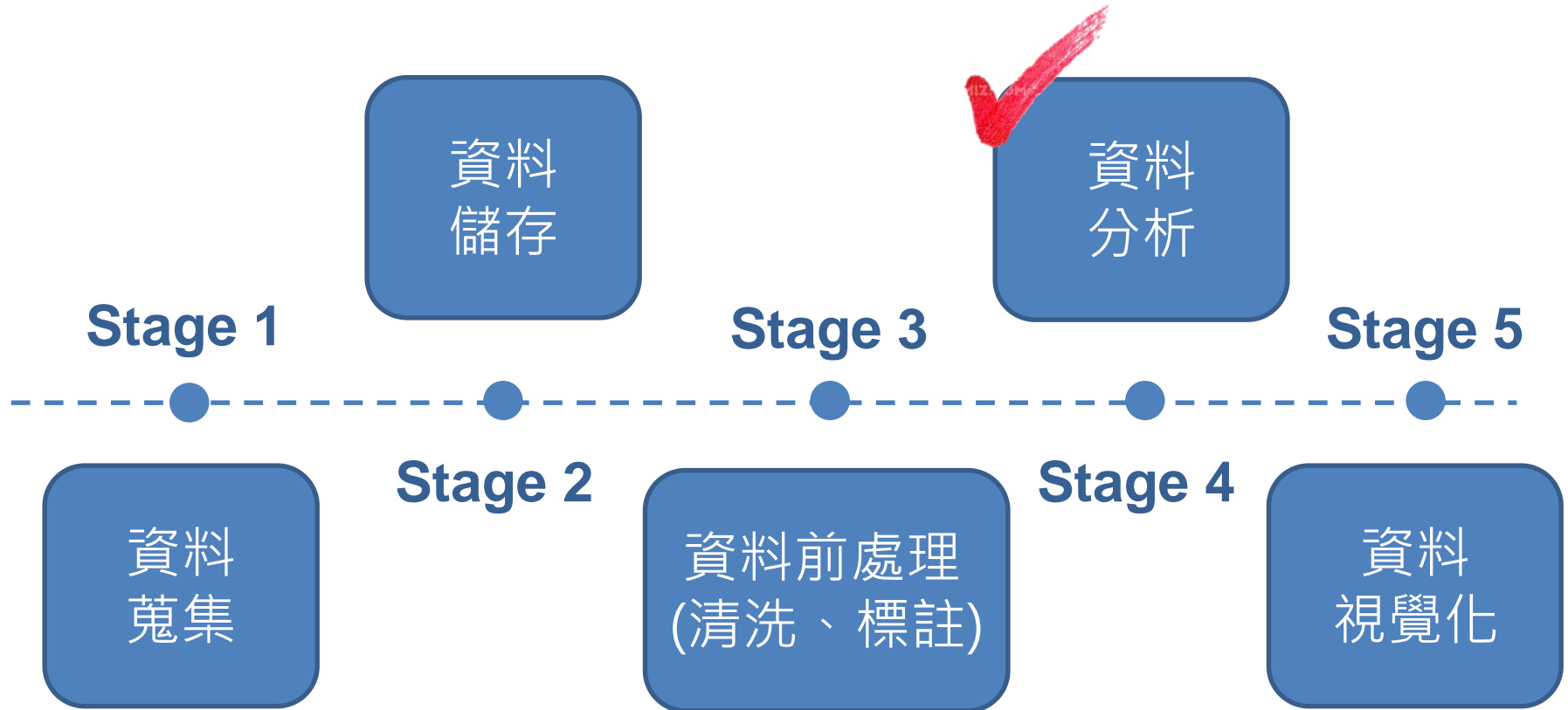
Like gardening

- **Seeds** = Algorithms
- **Nutrients** = Data
- **Gardener** = You
- **Plants** = Programs

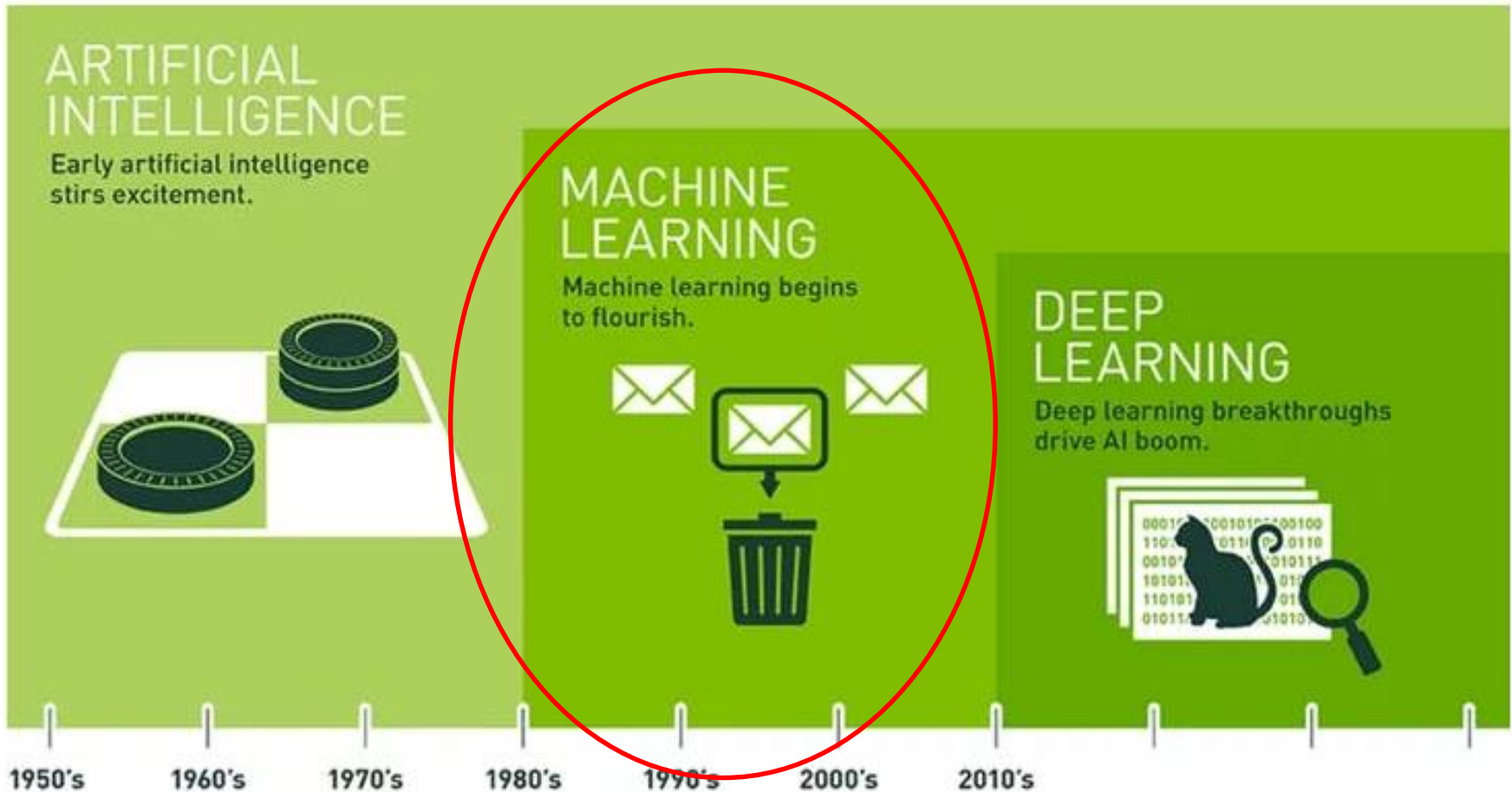
You can do it!



AI and Data Analytics



人工智慧 (AI), 機器學習 (ML), 深度學習 (DL)



圖片來源：NVIDIA